

Summary of Impacts of
an Extension of Collider Run II
on
MINERvA, g-2, Mu2e, LBNE, Project X,
etc.

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Outline

- Programmatic Impacts on Experiments
- Budget Considerations

MINERvA Physics Program

- Low Energy:

Exclusive states as input to oscillation experiments; elastic and near-elastic processes as a probe of effects of the nucleus.

- Medium Energy:

Switch focus to inclusive scattering, e.g., to get nuclear PDFs.

- * Rates of interesting processes are much higher.
- * This physics needs significant anti-neutrino beam, and so is well matched to operation in the NOvA era.

MINERvA Opportunity

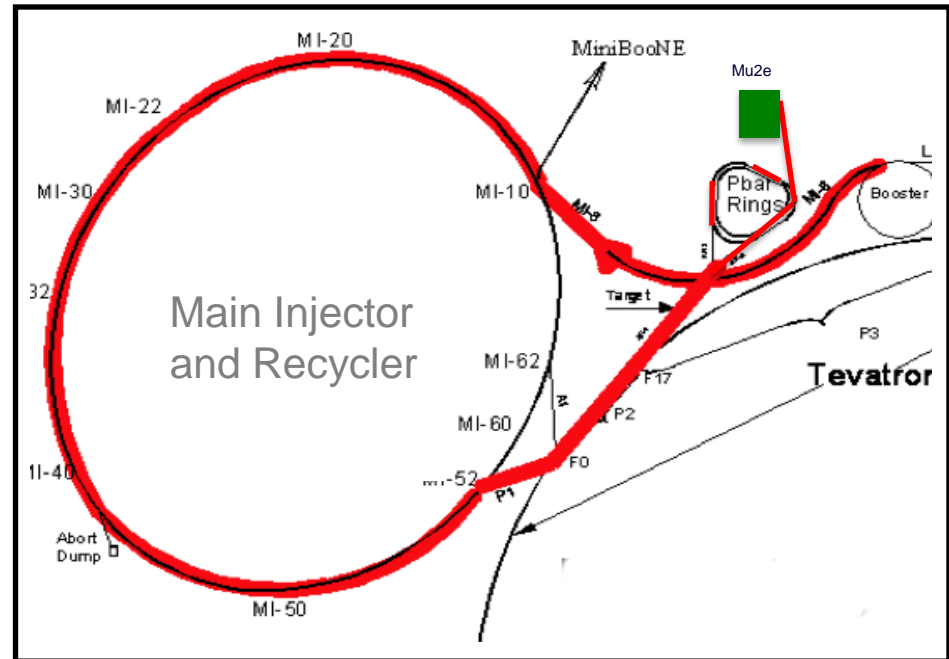
- An increased low-energy exposure would give a significant gain in MINERvA capabilities. Low-energy results will be statistics-starved – up to at least a factor two more protons on target than currently planned.
- Balancing MINERvA and NOvA beam use, any delay in the “NOvA” shutdown (e.g., as for a longer Collider run) will allow more low-energy beam to be delivered to MINERvA.
- Delay in the medium-energy exposure is not of primary concern to MINERvA since MINERvA will still do those measurements as NOvA takes data.

New Muon g-2 Experiment

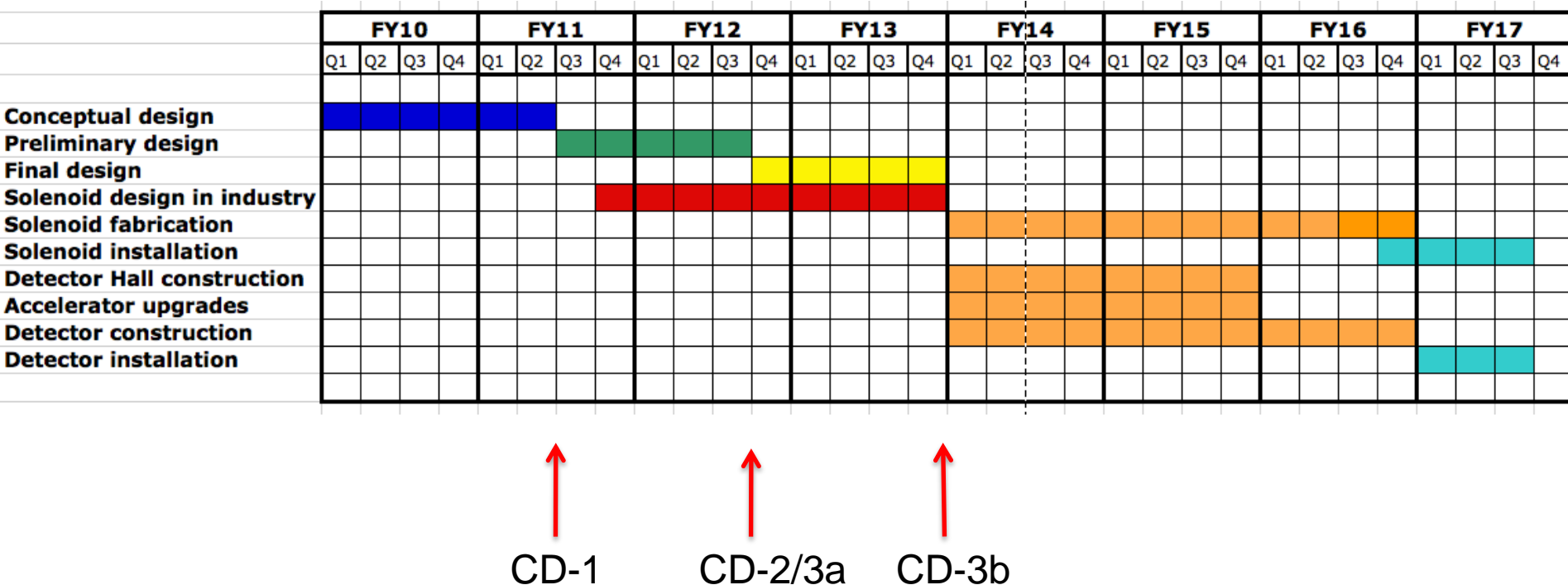
- The proposed building site near AP0 could not be constructed during Tevatron running. A new site would need to be found and a new building constructed for the detector. The time critical-path is the relocation of the muon storage ring to Fermilab.
- The beginning of data collection would be delayed between 12 and 24 months from the present technically-driven schedule.
- A Run II extension would not impact the physics reach of the experiment, but would delay the availability of a new muon (g-2) result to further constrain the interpretation of new results found at the Tevatron or the LHC.

Mu2e

- Mu2e takes protons from the Booster, runs them through the Recycler to the Pbar Source and then slow-extracts through a new external beamline to the detector.
- About 1.5 - 2 years of work is required in the Pbar Source to prepare it for Mu2e.



Impact of Run II Extension on Mu2e Schedule



- The earliest that Mu2e could begin work in the Pbar Source and Recycler is FY15
 - CD-3b in FY14
 - ~ 1 year to build/procure magnets, RF, etc.
- An extended Run II would not directly impact Mu2e's ability to access the accelerator complex on schedule.

Resources and Mu2e

- The largest impact of extending Run II could be on the resources available from the Accelerator Division (AD).
- AD is already overextended with Run II, NOvA, LBNE, Project X.

NOvA rolloff will help, but an extended Run II will consume significant effort needed by Mu2e, LBNE, and Project X to scale up to their required level. This could translate into schedule delays. And, schedule delays translate into cost increases. If additional funds are available, additional manpower could be hired and/or effort outsourced.

- An extended Run II will slow the migration of physicists from the Energy Frontier to the Intensity Frontier.

Impact for Mu2e – several CDF and D0 physicists are expected to play significant roles.

LBNE (1)

- The largest potential impact on LBNE of an extension of Run II is budgetary – IF there is no increase in total Lab funding.
- The main impact would be on the beam design. LBNE is counting on quite a number of people to work on the preliminary and final designs, who also have operational responsibilities.
 - Among 15 individuals who are already working on LBNE part time, or counted on for specific tasks, expect to lose about 5 FTE's until the end of an extended Run II.
 - Likely an additional comparable number of currently unidentified FTE's that would also be diverted away from LBNE.
 - The total would be, therefore, about 10 FTEs for 3 years, ~ 20% of the planned effort during FY12-14, when LBNE will be moving through CD-2 towards CD-3 (around the end of FY14).
 - This would risk delaying CD-3 by an estimated (up to) 6 months.
- However, with additional funding to Fermilab, additional manpower could be hired and/or effort outsourced.

LBNE (2)

- An additional complication if able to hold to current schedule, the CD-3 review would occur just before the beginning of the 8-month shutdown for ANU upgrade installation. If the 6-month delay estimated in the previous paragraph occurred, then the CD-3 review would be in the middle of the shutdown. Some of the key experts on the primary and neutrino beams would also be involved in the shutdown, likely causing a further delay in readiness for CD-3.
- The people currently working or planned to be working in the future on the detector systems (Near Detector, Water Cherenkov Detector, Liquid Argon Detector) and on conventional facilities are generally not involved in Collider operations, either on the accelerator or detector sides, nor is LBNE counting on facilities that would remain tied up by an extension of the run.

LBNE (3)

- One potential positive effect on LBNE:

With a later shutdown, LBNE would have time to prepare to make tunnel connections to the existing NuMI line and to the 8 GeV transfer line during the “ANU shutdown”, decoupling most civil construction and some beamline component installation for LBNE from accelerator operations after that, simplifying the LBNE project.

- Potential to increase NOvA running time via less LBNE overlap of access needs.

This, of course, supposes a CD-3a and adequate construction funding in FY14 and FY15 to execute this work early.

Project X, SCRF, and the Muon Accelerator Program (MAP)

- About 70 (accelerator) FTE's are engaged in Run II who would otherwise be available for Project X, SCRF, and MAP programs (as well as for LBNE, Mu2e).
- The current plan is to build up the FTE's from the currently assigned (~150) to that foreseen in FY12-14 (~200) from people coming off Run II efforts.
- If Run II were extended, this growth could only occur with additional funding to Fermilab.
- If there is no additional funding, this would likely delay ability to be prepared for a Project X construction start by 1-2 years, and would probably also impact the ability to complete the primary MAP deliverable - the Muon Collider Design Feasibility Report - on the desired schedule (2016).

Illinois Accelerator Research Center (IARC)

A extension of Run II would impact the schedule and funding for the decommissioning of the CDF experiment. This in turn determines when the CDF Assembly Building could be made available for refurbishment as part of the Illinois Accelerator Research Center. Construction of the State-of-Illinois-funded IARC building adjacent to the CDF Assembly Building in FY11-12 is expected to have minimal impact on CDF or Tevatron operations.

Budget Considerations

- Incremental M&S costs of Collider operations are ~\$18M (\$13M power bill + \$5M consumables). How much of this comes out of Mu2e, LBNE, Project X, SCRF, MAP, etc. depends on the incremental funding received from DOE to support the extension and programmatic decisions made on how any shortfall is shared. Labor costs are additional, to these costs (See next slides).
- For example, the incremental LBNE funding in FY12 and FY13 relative to FY11 is a large fraction of the expected savings from the completion of the Collider run. The latest LBNE DOE guidance is \$12M, \$35M and \$60M in FY11, 12 and 13, respectively, compared with expected savings from the end of Run II that are something like \$25M and \$40M in FY12 and 13, respectively.

Laboratory Working Budget Profiles

(in Then-Year M\$)

	<u>FY</u> <u>2010</u>	<u>FY</u> <u>2011</u>	<u>FY</u> <u>2012</u>	<u>FY</u> <u>2013</u>	<u>FY</u> <u>2014</u>	<u>FY</u> <u>2015</u>	<u>FY</u> <u>2016</u>	<u>7 YEAR</u> <u>TOTAL</u>
Add'l 3-year Tevatron Run			25	40	45	25	15	150
MicroBooNE	2	8	6	4				20
Mu2e	5	10	30	60	50	30	15	200
LBNE	11	12	35	60	80	135	185	518
Project X	6	10	15	16	17	32	45	141
NOvA	60	46	41	20				167
DECam	8	4						12
Tev Ops	60	60	35	20	15	10	5	205
Total w/o Add'l Run	153	150	162	180	162	207	250	1,264
Total w/ Add'l Run	153	150	187	220	207	232	265	1,414

Laboratory Working Budget Profiles

